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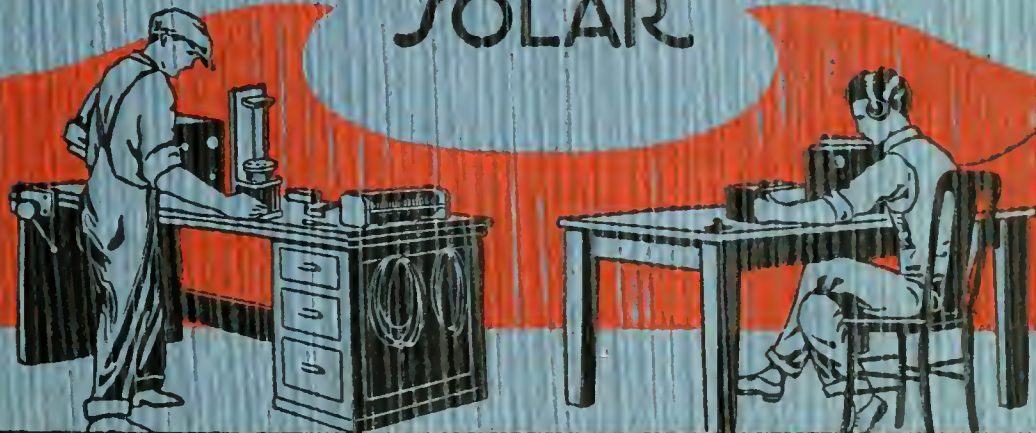
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RADIO CRAFT

SOLAR



RADIO CRAFT

Booklet No. 1





Model Illustrating Arrangement of Radio Receiving Set.

Handcraft Projects for School and Home Shops

RADIO CRAFT

(Radio Booklet No. 1)

FRANK I. SOLAR

Northern High School, Detroit, Michigan.

Editor of "Tool Craft," "Toys and Useful Articles a Boy Can Make,"
"Practical Construction Work for Home and School Shops,"
"Bird Houses of Simple Construction"



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RADIO SETS AS MANUAL TRAINING PROJECTS

The making of toys, boats, bird houses, kites and aeroplanes have all been accepted in turn with great enthusiasm by boys in manual training classes. Nothing however, like the Radio Craze has ever caused the boys to beg to come in and work, the girls to inquire if it would be possible for them to do work, and fathers and mothers, to come to our shops for parts and information, for setting up Radio receiving sets.

Most of the projects made in our shops such as book racks, etc., will serve the purpose if $\frac{1}{4}$ -inch longer or shorter than the drawing. This is not true with the wireless receiving set, which requires less material than the usual models, but each part must be a certain size to make the next part work, and the boy appreciates the meaning of real accuracy. It also instills in him a desire to search the shelves of the public library and to study books on this subject. It makes him rack his brain to figure out how to make use of available scrap material to take the place of parts that he has not the money to purchase.

The crowning feature, however, of this project is that when finished it looks so different from the usual

article the boy brings home, almost like an infernal machine, that the whole family is interested to the extent of offering their help to get the thing rigged up for a tryout. This is so different from the usual interest shown when the boy's work is brought home, which consists of an expression— isn't it nice. Then the article is forgotten.

The boy has a chance to tinker with the elements and with many different kinds of materials. This is the best kind of education, and the desire for learning comes from within. It is a chance for father and son to get together and work on a problem that is of interest to both.

Let the boys experiment, for it will drive them off the streets into the school and home work shops where every boy and man should spend some of his spare time. While there he will make articles that will not only afford pleasure and pastime but will be a benefit educationally to the household. Let the good work go on.

F. I. S.

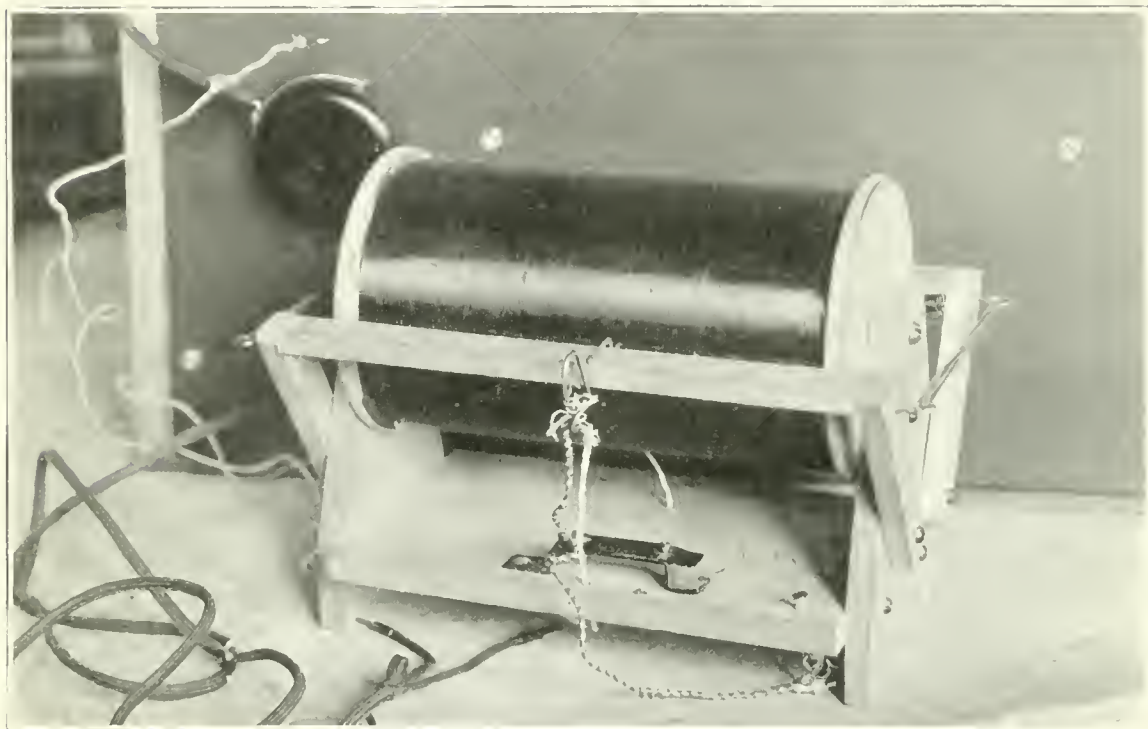


Illustration 1. Tuning Coil. See page 16.

RADIO CRAFT

Radio and wireless experimenting by amateurs in this country had gotten nicely underway about the time the World war started. Due to the fact that war department regulations required aerials to be dismantled, amateurs had to lay aside their equipment for a while. However, after peace was declared experimenting soon became popular again. After the special training received in service many more young people were interested and had considerable more practical and theoretical knowledge of the work than those interested before the war.

The average person was not any more interested in Radio, than in any other new feature brought to his attention. The reason for this was that most broadcasting was done in code, and it is a considerable task to master the code so one can receive. And even for those who could receive, the information gained, was of little interest.

When different agencies began broadcasting music, entertainments, lectures, news, etc., to be heard by the aid of the radio-phone, everyone became interested. And today we have thousands of people all over the world enjoying entertainments daily.

There are no laws governing the use of receiving sets and the handy person can make one that will receive the broadcasting in his vicinity. The sending, how-

ever, requires an expensive apparatus and also a license, the obtaining of which involves certain qualifications and requirements. This is of little concern to most people as they are content to listen to others of interest rather than spend their time jamming the air.

Almost any of the apparatus used for broadcasting and receiving can be made or assembled by the handy man, boy and mechanic. Although material required is quite expensive for the larger outfits, the average expert worker, even if competent to make a set, could not afford to invest a great amount in material. Persons who can afford to will no doubt buy a complete set, and even if they were capable would not have the time to make their own sets. There are thousands of people who would like to listen in on the programs offered. They would like to make their own outfits and can do so by following the directions given in the following pages.

The following drawings and instructions are given to be used by the handy man and boy in the home and school shops. It is not intended to give any technical discussion in this description but to show by drawings and a brief explanation how to set up a receiving outfit at a minimum cost. This set is similar to many that my boys have already made. By the aid of such sets they are receiving great enjoyment listening to the code and the wonderful programs they are able to get.



Illustration 2. A Portable Home Made Outfit.

One of these little receiving sets will be worth a great deal to the busy mother unable to leave home evenings, to crippled people confined to their beds or chairs, to convalescents, and people living far out in the country and at resorts in the summer time.

Do not be misled by statements that for a dollar or two you can make a set that can be connected to your victrola and heard all over the house, or that will receive concerts broadcast at a great distance. This is not true. To do this requires a set composed of at least the following equipment, in addition to the receivers and aerial: a rheostat, amplifier panel, bulb, grid condenser, grid leak, six volt (A) battery and a (B) battery. An outfit of this kind costs \$65 and up.

The wireless and radio-phone are still in an experimental stage and it is advisable to investigate and pick a reliable standard set rather than to invest considerable money in inferior wireless apparatus. In a short time marvelous new equipment will be on the market and an outfit may be hooked to the electric circuit and even the ordinary telephone may be used to receive broadcasting. It would be well worth while for those interested in this new venture to make a home made receiving set first and do a little experimenting until they decide on the larger set they want. Most of this beginning apparatus can later be hooked in with the more expensive set.



Illustration 3. A Pocket Outfit.

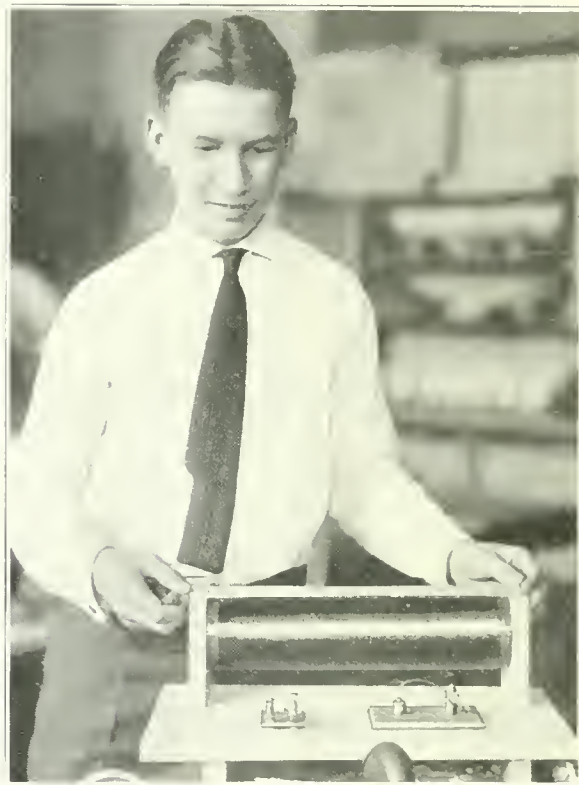


Illustration 4. A Tuning Coil and the Boy Who Made It.

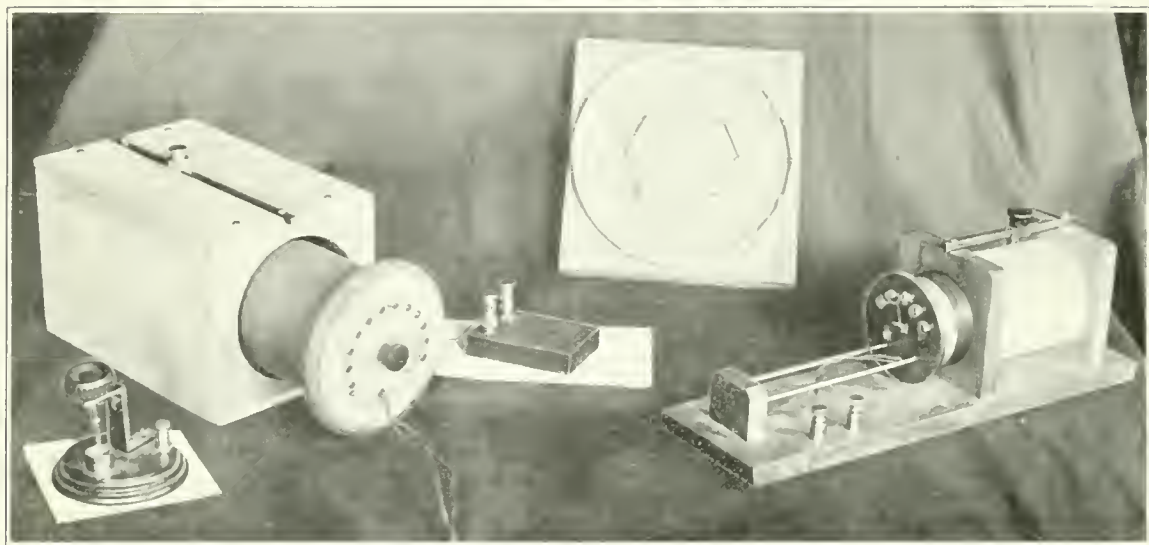


Illustration 5. Home Made Loose Couplers, Condenser, Detector and Coil Wound on Nails.

THE AERIAL

The first thing to be considered when installing a receiving set is the aerial. Of course it is possible to get results from your bed springs, the eaves trough, a metal railing and many other things, but naturally a specially erected aerial is the most satisfactory.

A loop aerial may be erected indoors. It may be stretched in the attic or any room. Some have strung the aerial across the room from the picture molding on one side to the molding on the other. A row of picture hooks or screw eyes will do to support it. While it is up out of the way it is not very convenient on house cleaning day. Two coat hangers hung at either end of the room will make good stretchers.

Sound waves travel through the ether and are caught by the antenna of the aerial, which is the part suspended between the stretchers.

Almost any length of aerial at any height from the ground will give results for receiving from a short distance. The higher from the ground and the longer the antenna the better.

Excellent results will be obtained by a 75 to 150 foot aerial placed from 30 to 50 feet from the ground. The antenna should be allowed to sag a little so it can blow in the breeze and thus shake off the snow and ice which might collect and break it if strung tight.

For small sets to receive from a short distance any kind of wire will do, either bare or insulated. The best wire to use is No. 14 copper or aluminum (bare). For guy wires use No. 10 or 12 telephone wire.

The laws require that amateurs send on not over a 200 meter wave length. The four wire aerial, illustrated in Fig. 1 is 75 or 80 feet long, and is about right for sending this length wave. The masts which are fastened and braced to the peaks of the roof may be any length. The stretchers should be about nine feet long and the wires equally spaced. At the free end M the wires may or may not be connected with each other. The other end N, from which the lead in is taken, should have each wire of the antenna connected to one that leads in to the instrument.

Fig. 2 shows a short one wire aerial having the masts fastened to the front and back of the house. Fig. 3 shows bicycle rims or barrel hoops used, where it is not convenient to get long stretchers.

Fig. 4 is an aerial stretched from a house to a garage and Fig. 5 shows one wired to chimneys on an apartment building.

Fig. 6 illustrates, at A and B, how ordinary porcelain cleats or glass pony insulators are used where the antenna is connected to the spreaders. The one wire aerial insulated, as shown in Fig. 7, is made as long as

possible and is the easiest to erect and will give good results. The loose ends can be attached to screw eyes screwed at any convenient place from the house to the barn, a tree, post or the garage.

A lightning switch, if large enough to be of any account, is rather expensive. A drawing for one that can be made from $\frac{1}{8}$ -inch or thicker sheet copper, and a cement base is given in Illus. 1. A box of wood can be made into which to pour the cement. Pegs should

be inserted in the cement while soft and pulled out after it has hardened to make holes for fastening to the window sill. The posts can be held in place by a piece of stick suspended over the top of the box while the cement is hardening. To conform to wiring regulations it will be necessary to place a plate of composition material beneath the cement.

A porcelain, glass or rubber tube may be used to insulate the lead in wire where it passes through the sash.

TUNING COIL No. 1

The radio waves are sent out in different lengths by different broadcasting stations. The ones you wish to receive must be tuned in so you can receive them. This is accomplished by moving the sliders on the sliding rods.

This outfit is made up complete so that by connecting your aerial at A your ground at B and your phones at G and H you are ready to tune in and receive.

The coil can be wound on either a cardboard tube or a solid piece of wood. If wood is used be sure it is well seasoned or it will shrink and your wire will hang loose on it.

The first thing to make is the coil. For this get a rolling pin and saw off the handles. To hold one-half pound of wire it should be $2\frac{5}{8}$ inches in diameter and $10\frac{1}{4}$ inches long. Make a groove with the marking gauge $\frac{1}{8}$ -inch from one end. Drive a brad alongside the groove and then give that end of the pin a coat of shellac. We are going to make the coil by winding No. 22 enameled copper wire around the pin. Twist the wire around the nail twice, about 6 inches from the end of the wire. This end is left for making a connection. Now wind around the pin, the first time around running the wire in the groove. This is done while the shellac is wet and it will help hold the wire in place when it

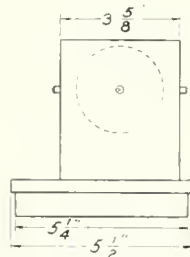
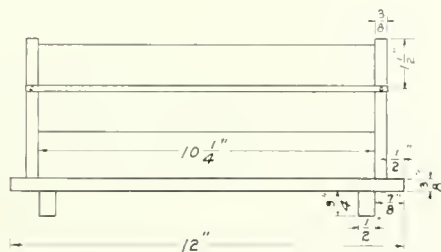
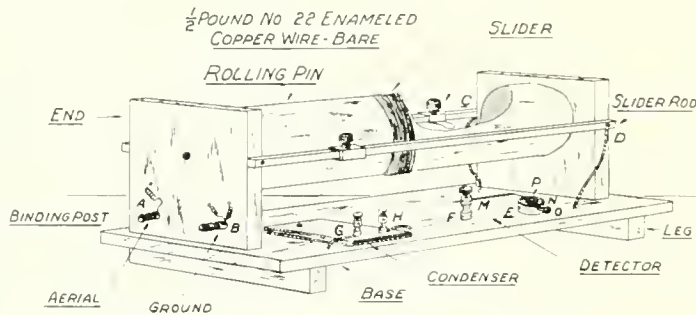
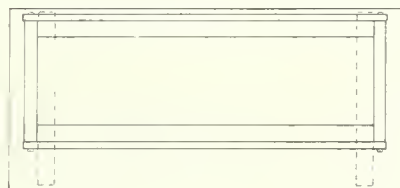
dries. If you shellac as you wind, it will not be necessary to get the shellac on your hands. When you have reached the other end of the pin drive another brad and fasten the wire as before but the six inches at this end should be wound around a pencil making a pig tail. This end has no connection.



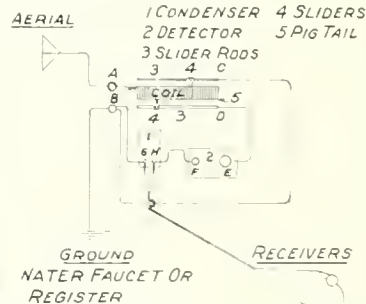
Illustration 6. Winding a Coil.

M- CAT WHISKER
N- CRYSTAL CUP
O- TIGHTNING SCREW
P- CRYSTAL

TUNING COIL No. 1.



PLAN FOR WIRING



Details of Tuning Coil No. 1.

Lay the coil aside and make the ends. Fasten them to the coil with screws about $1\frac{1}{2}$ inches from the top of the end pieces. Next make the base and fasten to the end pieces and then the legs and fasten them to the base.

Now if you wish to purchase your parts, buy two $\frac{3}{16}$ -inch square brass slider rods and sliders to fit. Also a condenser and a detector. If you wish to make all parts, information for making them can be had from following drawings.

Your connections can be made at the end of the slider rods by fastening the wires under the brass round head screws that hold the slider rods in place.

Now we shall wire the tuning coil. Bore holes for the binding posts at A and B and also for the wires that are connected to them. Connect straight wire left at the end of the coil to A, after running it through the

hole in the end piece and scraping off the insulation to make a good connection. Connect wire to the end of the slider rod at C, run through the hole in the base, across underneath the base, up through the hole at the opposite end and through the one in the end and connect to B. Connect a wire to post G on the condenser and run through holes to post B. Connect H on the condenser to F on the detector. Connect E the crystal cup screw with slider rod D.

The cat whisker of the detector is lettered M, the crystal P, the crystal cup N and the set screw O.

The wood work on this instrument should be stained and shellaced or varnished to add to its appearance.

Scrape the enamel from the wire where the points of the sliders touch. Be sure all connections are well made and no insulation is left between them.

This instrument is ready for use.

TUNING COIL NO. 2

This coil has the same capacity as coil No. 1 but can be made much cheaper as the wire is the only thing that need be purchased.

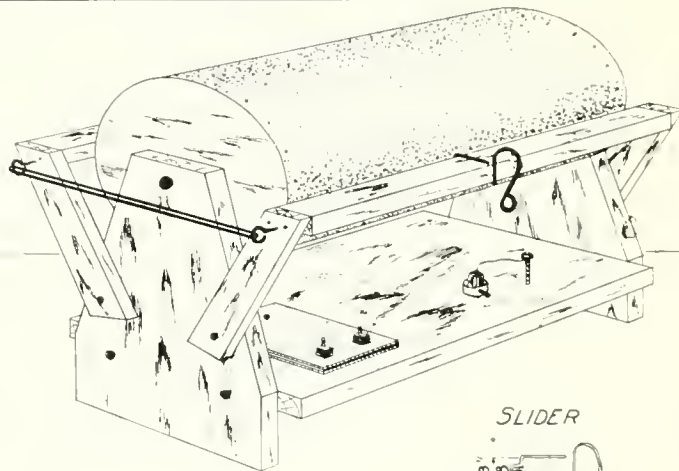
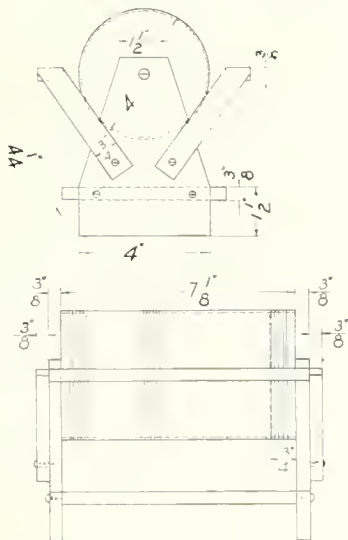
An ordinary oat meal or cereal box is used in place of the rolling pin on which to wind the coil. Be sure that the cereal box is dry and give it a coat of shellac to stiffen it. If the coil is wound on a damp box, the wire will come loose when the box dries out.

Begin work on this instrument by making and winding the coil. The top and bottom of the box are removed and wooden discs are tacked in the ends of the tube. The discs can be sawed to shape with a coping saw.

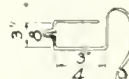
Make the wood frame for holding the coil. This needs no further explanation, as the construction and sizes of different parts can be learned from the drawing.

TUNING COIL No.2.

THIS COIL IS CAPABLE OF RECEIVING AS WELL AS No.1 BUT AS NO RODS, SLIDERS OR POSTS ARE USED ONLY WIRE NEED BE PURCHASED



SLIDER



NO 14 COPPER WIRE
MAKE TWO

Details for Making Tuning Coil No. 2.

The sliders are made of wire and slide on the wooden frames connected to the uprights at the ends. This saves the expense of slider rods, etc.

The winding of the coil and the wiring of this instrument are the same as explained for Coil No. 1.

Screw eyes and rubber bands should be adjusted, as shown on the drawing, at both ends of the instrument. The rubber bands hold the points of the sliders in close contact to the coil. Scrape the insulation where the sliders touch the coil, as instructed for Coil No. 1.

The instrument should be stained and shellaced or varnished to add to its appearance.

Instead of hooking to the end of the slider rod, as instructed for Coil No. 1, on this coil hook to the eye in the slider itself.

MAKING THE CONDENSER

It is the practice in connecting up receiving sets to use a small fixed condenser across the telephone terminals. The condenser acts as a stopping condenser. In small set hook ups some are able to get results without the condenser.

Materials needed for the condenser are as follows:

- 1 Piece of wood, $\frac{3}{8}$ x $3\frac{1}{4}$ x 6 inches.
 - 2 Pieces of Cardboard, $3\frac{1}{4}$ x $5\frac{3}{8}$ inches.
 - 10 Sheets of tin foil, 3 x $4\frac{1}{2}$ inches.
 - 11 Pieces of waxed paper, $3\frac{1}{4}$ x 4 inches.
 - 2 Binding posts.
 - 4 Pieces of thin sheet brass.
- Some vaseline.

Begin making the condenser by cutting 11 pieces of waxed paper according to pattern C.

Next cut ten pieces of tin foil according to pattern B and two pieces of cardboard like pattern A.

Place a piece of cardboard A on the table and with the fingers spread on the upper face a thin covering of vaseline, just enough to hold the first sheet of waxed paper in place. Lay the first sheet of waxed paper C, on the cardboard and grease the upper side as you did the cardboard. Now place the first sheet of tin foil on the waxed paper, with the $\frac{3}{8}$ " x $\frac{3}{4}$ " projection, extending at one end. Continue piling up the pieces as indicated on the drawing. The next piece of tin foil should have $\frac{5}{16}$ " x $\frac{3}{4}$ " projection, extending at the opposite end. Continue greasing and piling the parts, being sure to alternate the projection on the tin foil sheets.

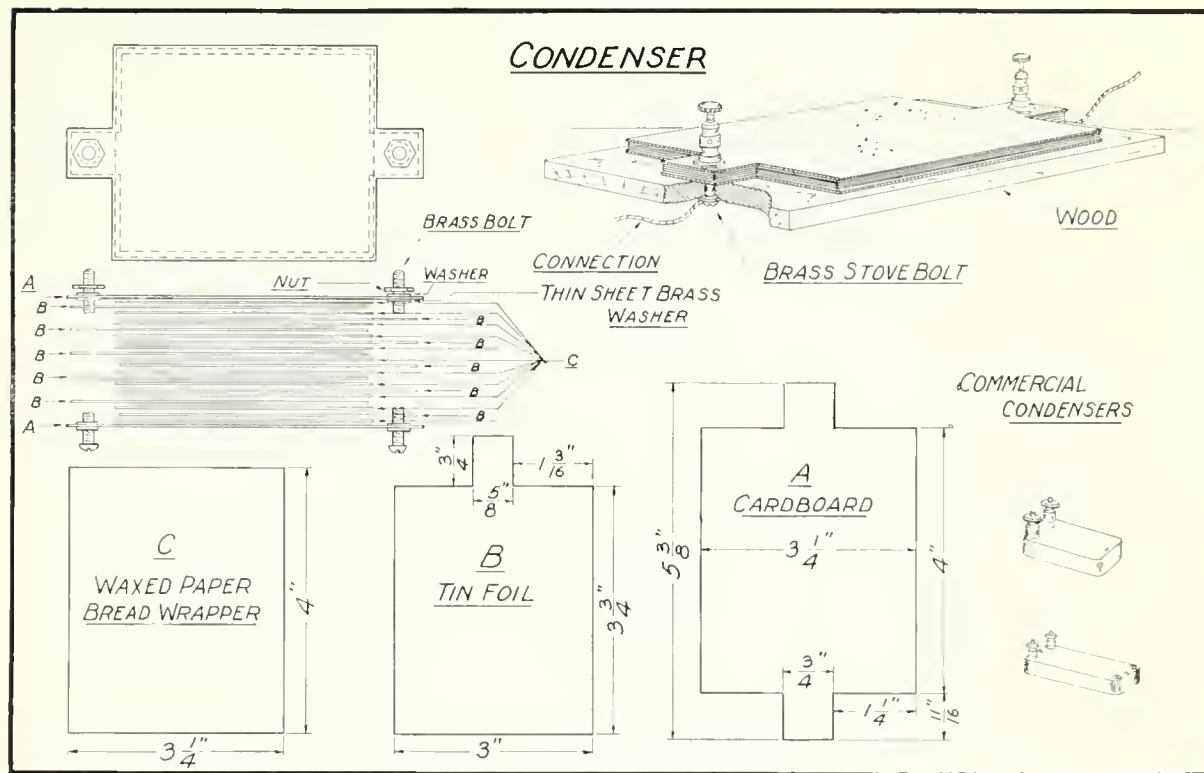
Cut the thin sheet brass washers and put in place.

Make the wooden base and bore holes for the binding posts.

Place the condenser on the wood, after it has been pressed together tightly. Locate and bore holes. Assemble according to the drawing ready for connecting to the set.

If desired the condenser may be connected directly to the base of the tuning coil instead of attaching to the wooden base.

In the corner of the drawing will be found pictures of commercial condensers, that can be purchased for from 30c to \$1, depending on the workmanship.



Details of a Home Made Condenser.

MAKING A DETECTOR

The sound waves as they are caught by the antenna are not of a desirable type of current. They must be changed to the suitable type and this is done by the detector.

The materials used for the commercial product consist of a wooden base, two binding posts, a crystal cup and a part called a cat whisker, which is nothing more than a pig tail made of bronze spring wire. The pig tail is made by winding the wire around a finishing nail.

The crystal is nothing more than lead sulphite and may be called galena, carborundum, silicon, etc. This mineral must be chipped off to make a bright surface and a good contact with the cat whisker. Dust soon gathers on the surface of the crystal. This can be prevented by covering the whole detector with a large drinking goblet or wooden box.

Practically every home made detector is made in a different way and of different materials. The reason for this is that there are only two essential points; first some means of holding the cat whisker so it can be moved about and adjusted on the crystal; and second some means of holding the crystal tightly.

The detector can be set up on a special base or on the base of the tuning coil.

For Type 1 get a piece of wood $\frac{3}{8}$ " x $2\frac{1}{4}$ " x $4\frac{1}{2}$ ", an old cuff or suspender clip, a piece of sheet brass, five round head brass screws and a piece of fine brass or bronze spring wire. Bend the clip and brass strip to form, as indicated on the drawing, and drill holes for the screws. If the hole for the cat whisker screw is made smaller than the size of the screw the screw when forced through the hole will tap out the hole. Assemble the parts, solder the cat whisker to the screw and a wing in the slot in the head of the screw. Insert the crystal in clip, and the detector is ready for business.

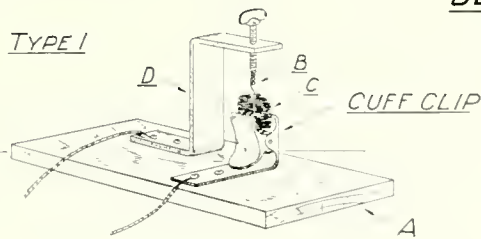
Type 2 is made similar to Type 1, except that all parts may be purchased and only the assembling is to be done. The connections in this case are made between the nuts at J.

The adjustment and sensitiveness of the detector are responsible for the success of your set. So it is quite important that you buy a good piece of tested mineral or crystal.

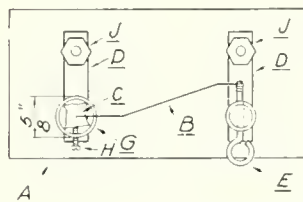
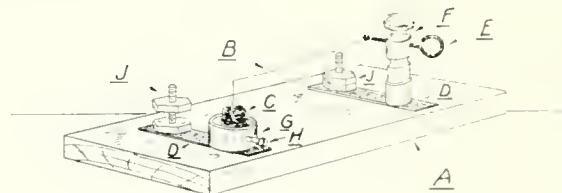
Be sure when making connections and before soldering any joints that all parts are well scraped. Not scraping off the insulation is often the cause of poor results.

DETECTOR

TYPE 1



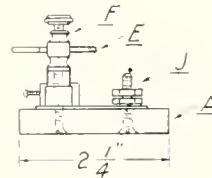
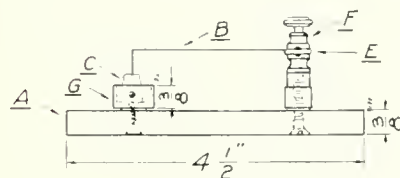
TYPE 2



COMMERCIAL TYPE



BOX OF GALENA



- A- WOOD
- B- No 36 BRASS SPRING WIRE
- C- GALENA
- D- SHEET BRASS
- E- HEAVY COPPER WIRE
- F- BINDING POST
- G- GALENA CUP
- H- SET SCREW
- J- BRASS STOVE BOLT & NUTS

Details for the Construction of a Detector.

RECEIVING TRANSFORMER OR LOOSE COUPLER

A loose coupler is more difficult to make than a tuning coil but it will give better results.

It is for the same purpose as the coil, i. e., to tune in the sound waves.

With this coupler, a good detector, a sensitive piece of galena, a pair of 2,000 ohm receivers, 100 feet of copper antenna well insulated suspended on an aerial 50 feet from the ground an operator should be able to receive from 200 to 300 miles.

The coupler is composed of two tubes both wound with wire, one sliding inside of the other. The larger tube is called the primary and the smaller the secondary. The primary is set to the wave length by adjusting the top slider. Then the switch on the secondary and the coupler (drawing the secondary in and out on the rods) are manipulated until the loudest sound is heard.

If you do not possess many tools and it would be difficult for you to make the box it need not all be made. The only parts needed are the bottom and the two ends.

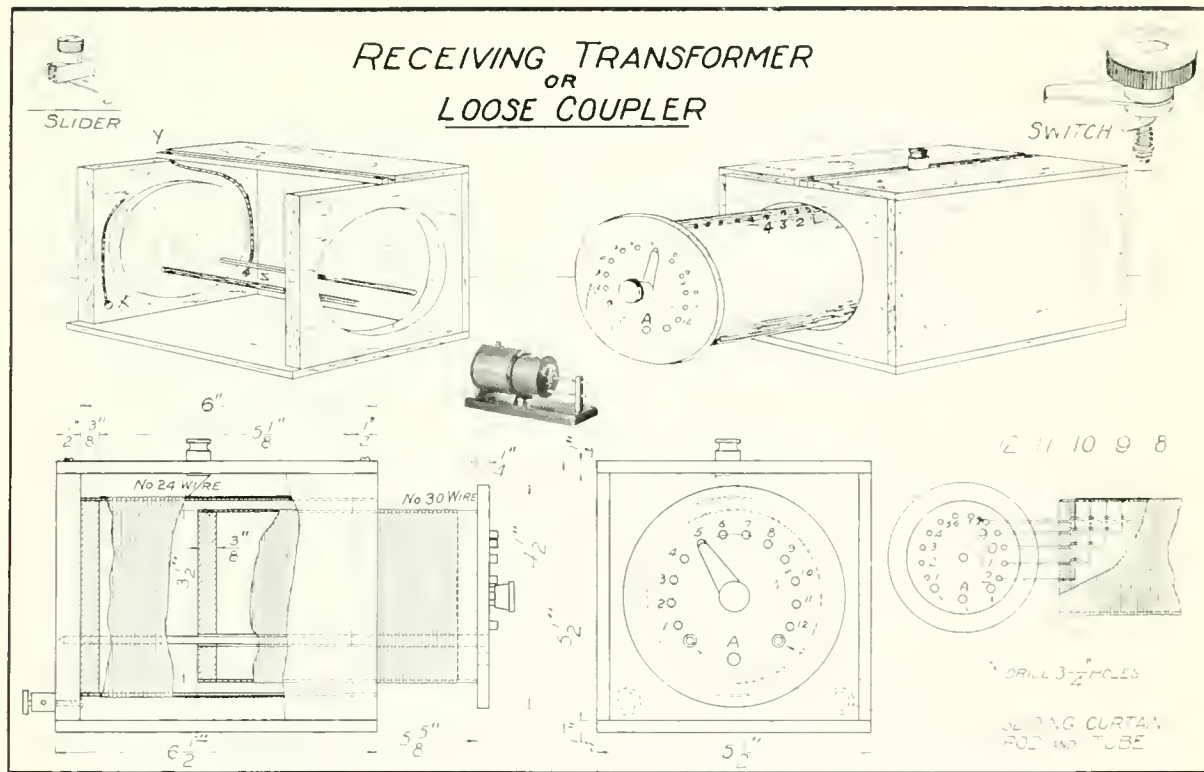
For the tubes get an oatmeal or other cereal box for the primary and a salt box for the secondary. Be sure they are dry before winding the wire on them, so they will not dry out and shrink after being wound. It will stiffen the cardboard to shellac it well before using.

With a coping saw, cut the opening in the front piece and then make $\frac{3}{8}$ " discs according to the drawing to fit the back of the primary and both ends of the secondary, also a $\frac{1}{4}$ " disc to fasten to the front of the secondary.

Get a $\frac{3}{8}$ " sliding curtain rod, that is one that has a tin tube in which the solid rod slides. Cut off two pieces of each tube and rod the length of the box. The tubes are to be inserted in the ends of the secondary and the solid rods are to be filed square and to a point and driven in holes through the disc in the back of the primary and into the back of the box.

Wind the primary with No. 24 cotton covered copper wire and when finished give it a good coat of shellac. It will take about one quarter of a pound. Start $\frac{1}{2}$ " from the end of the box. Fasten the ends by punching small holes in the cereal box and threading the end of the wire into the box. The wire at the back end should be twisted so it will not come loose; but the one at the front end should be left quite long, as it is to be threaded back through the box and out at the back end where it is fastened to the binding post (X).

When the primary is wound it should be tacked with $\frac{1}{2}$ " brads to the disc at the back and to the circumference of the hole cut in the front piece.



Details for Making a Loose Coupler and Picture of Commercial Type.

Purchase or make a slider, and also get a $\frac{3}{16}$ " slider rod $6\frac{1}{2}$ " long. Fasten the rod to the top of the box as indicated and connect it to a binding post at Z with a piece of insulated wire having one end turned under the screw at Y.

Now we shall wind the secondary. For the secondary we need about one quarter pound of No. 30 silk covered copper wire, a rotary lever switch, twelve $\frac{1}{4}$ " taps or brass headed tacks and two pieces of flexible copper wire, each 18" long. Silk covered electric light cord will do for the flexible wire.

Along the top of the secondary, divide off the space into twelve parts and at each division punch a hole with a darning needle. Start about $\frac{1}{2}$ inch from the end to make the divisions and end about this distance from the other end. Start winding by threading the end of the wire through the first hole No. 1 at the back end of the secondary. Scrape the end of this wire and solder it to one end of one of the pieces of flexible wire. This flexible wire is to be threaded out of the tube through hole A when this front disc is finally fastened in place. Start now and wind until the wire comes to the center of the next hole. *(Do not cut the wire but make a long loop that will reach two inches out of the front of the tube)* thread through hole No. 2.

Continue to wind and loop through holes until hole 12 is reached.

Now scratch the insulation off of the wire at the end of each loop and fasten under the nut of the taps or solder to the ends of brass-headed tacks, if they are used for taps. Of course the location of the taps must be spaced off on the front disk of the secondary and holes bored for them, and also for the switch. Fasten one end of the other flexible wire to the switch post inside the tube and thread out with the other flexible wire through hole A. Now place the front head in the tube and fasten with $\frac{1}{4}$ " round head screws so it can be easily removed if repairs have to be made to the wires inside of the tube.

Scratch the insulation off the wire coil on the primary, directly under the slider rod so that the slider will make a good contact. The tongue of the slider will have to be bent no doubt to the proper shape.

For the hook up look at the diagram on the sheet of hook ups.

Z is connected to the aerial, X is connected to the ground, the switch of the secondary to the condenser and the other flexible wire from hole 1 to the detector.

To improve the looks of your instrument stain mahogany, varnish and rub down or enamel it black.

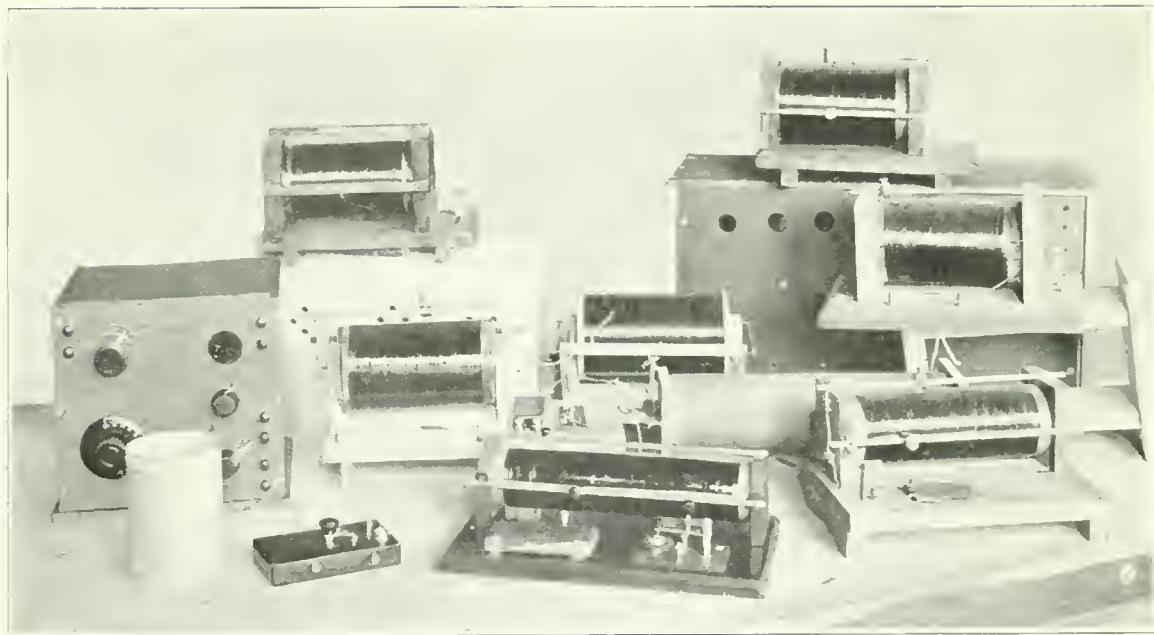


Illustration 7. Radio Apparatus Made by Boys Under the Author's Direction and Successfully Used.

HOO K UPS FOR COILS AND COUPLER

The term hook up is one used commonly by radio operators and means the method of wiring the pieces of apparatus together to make up a set.

There are many different ways of wiring or connecting the instruments together to get results and little difference can be noticed by the different methods. So if by chance you connect your set differently from the diagrams given on the drawing you may get just as good results.

We shall trace the hook up in Fig. 1. The aerial A is connected to the lightning switch at the center post B by the lead in wire, X. If you cannot afford a lightning switch, arrange your lead-in wire so it can be disconnected from the post B, fastened to an iron weight and swung at least 6 feet away from the house to the ground when not in use. If you have a switch connect the ground post C by a piece of No. 6 wire to a piece of gas pipe, driven into the ground. When not in use throw your switch to this post C.

Connect post D with the end of your coil wire E. The other end of your coil wire is pig tailed and has no connection, as F. Connect H to your water faucet, a radiator, or a wire run to a pipe driven in the ground at G. Also connect one post of your condenser J to your ground wire G. Connect the other post E of your condenser to post L of your detector N. Now connect

post N of your detector to post O the end of the other slider rod and your circuit is made.

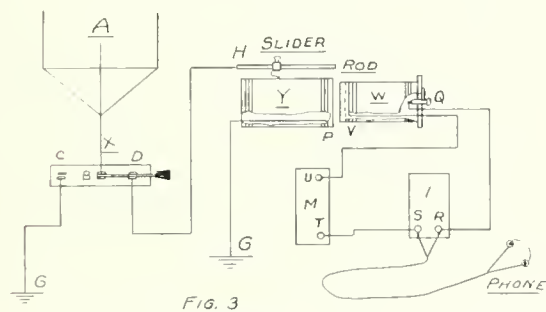
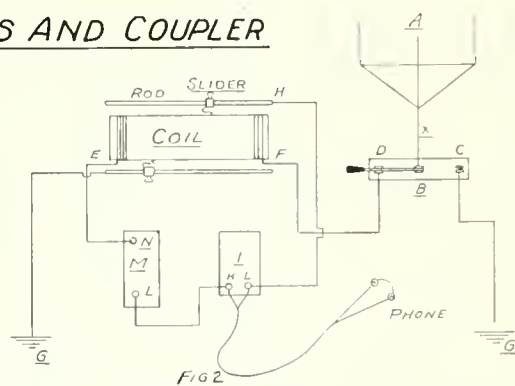
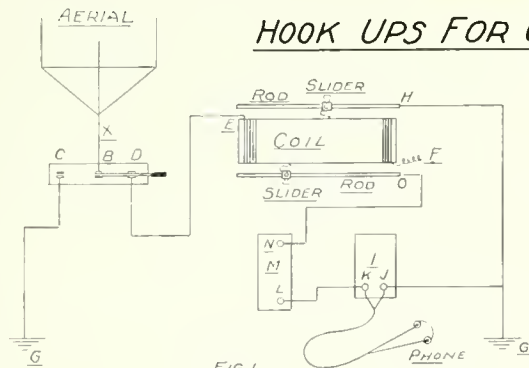
The terminal of your receivers should be hooked to the binding posts at K and J on the condenser.

Receivers are made in different types. A commonly used kind is the ordinary telephone receiver which is about 75 or 80 ohms. This type is not very satisfactory because it must be held by the hand while receiving. The amateur one-part head piece, which is also about 75 ohms, just brings the message to one ear and allows surrounding sounds to go to the other. The two part head set of from 2,000 to 3,000 ohms is very satisfactory. A 2,000 ohm head piece means that each part is a 1,000 ohm unit.

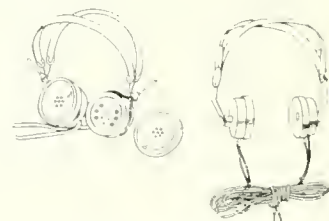
Fig. 2 shows another hook up for the tuning coil and can be easily traced after reading the description for Fig. 1.

Fig. 3 is a hook up for the loose coupler. The aerial in this case is connected with the slider H. The front end of the primary wire P is connected to ground G. The switch Q is connected with flexible wire to the post R of the condenser I. The post S of condenser is connected to post T of detector. The post U of the detector is connected with flexible wire fastened to the end of the wire at the back end of the secondary W. Y is the primary.

HOOK UPS FOR COILS AND COUPLER



A-AERIAL
X- LEAD IN
G-GROUND
M- DETECTOR
I- CONDENSER
Y- PRIMARY
W- SECONDARY
Q- SWITCH



HEAD SET RECEIVERS

Diagrams for Hook Ups.



Illustration 8.
Even the Doll May Share the Evening's Broadcasting.



Illustration 9.
Making Work a Pleasure with the Radiophone.

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